

WEDNESDAY, MARCH 25TH, 1896.

The Twenty-Second Annual General Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, March 25th, 1896.

The President, Mr. Henry Deane, M.A., M. Inst. C.E., F.L.S., &c., in the Chair. The minutes of the previous Annual General Meeting were read and confirmed.

The President then read the Annual Address.

 PRESIDENT'S ADDRESS.

It was with very great diffidence that I accepted last year the honourable position which you thought fit to confer upon me. It seemed to me that the man who was selected to stand at the head of such an important Society as this should be one, who, if not actually professionally engaged in matters connected with the science of biology, had sufficient leisure to permit of his devoting a large amount of his energies to the subject.

As you are, perhaps, aware I have for some years past found my time both in and outside office hours so much engrossed in matters pertaining to my profession, that the actual scientific work that I am able to carry out is very small. You may therefore suppose that the preparation of an address of this description is to me no light task, and I am sure you will accord me some leniency, if it falls below the average of the able addresses which my predecessors in this chair have accustomed you to.

At the outset I may remind you that to-day we commemorate the Society's coming of age. On the 13th of January, 1875, in a rented room in Lloyd's Chambers, 362 George Street, the Society held its First Annual General Meeting, and on the 25th of the same month the First Monthly Meeting for the reading of papers and the transaction of scientific business. In the history of a corporation this may not be an event of such importance as it

is to the individual; still it marks the fact that infancy and childhood so to speak are safely passed, and the difficulties connected with the early growth of a Society successfully combated.

The history of the Society has quite recently been so fully dealt with in the Introduction to the Macleay Memorial Volume, that I need not go into it on the present occasion, but there are a few matters connected with the work of the Society to which I will briefly refer.

There is the increasing responsibility which, more especially in respect to financial matters, ever since Sir William Macleay's retirement from active work, has devolved upon the Council. Up to the time mentioned Sir William Macleay relieved the Council of such burdens. Nevertheless the harmony which characterised the meetings of those days continues undisturbed, and the desire of the members to cope fairly with the greater responsibilities is evidenced by the high average attendance of members at the meetings. This development in the financial aspect of the Council's work is one which should be allowed due weight in the selection of members to sit on the Council. The claims of the scientific aims of the Society to be represented are not in danger, as we have many active members ready to look after its interests in this respect. The endowment fund, lately increased by the addition of the Bacteriology Bequest, amounts to over £30,000. To invest wisely and to keep wisely invested so large a sum, the duty of which devolves on the Council, requires the selection of a fair proportion of members skilled and experienced in financial matters.

The Proceedings of the first two years of the Society's work were issued as Volume I. In the course of the next few weeks the publication of our twentieth volume will be completed. While a high average of value has been maintained we have, in amount of matter published annually, outstripped most of our sister Societies in Australasia, and our ability to do this we owe to the beneficence of Sir William Macleay.

In his address last year my predecessor, Professor David, furnished full particulars of what, it was supposed, was the final settlement—so far at least as this Society was concerned—of matters relating to the late Sir William Macleay's bequest for the endowment of a lectureship in Bacteriology. It was with some surprise, therefore, that in July last the Council received from the Senate of the Sydney University an intimation of its intention to relinquish the bequest, and to return the money to the executors. This was subsequently done, and the money paid by the executors into Court. On October 15th, 1895, on the petition of the Society, the Chief Judge in Equity made an order for the payment to the Society of the sum in question, less costs, namely, £12,704. This amount represents Sir William's original bequest of £12,000, less legacy duty and law costs, plus interest accruing on fixed deposit from the time of the receipt of the money by the University until that of its repayment to the executors.

It devolves upon the Council, as the managers of the Society's affairs to provide for the investment and to keep invested the money to the best advantage; and out of the income to pay a competent Bacteriologist, and provide and maintain a suitable laboratory and appliances.

The clause of the Memorandum attached to Sir William Macleay's will is as follows:—"Should the Senate decline all or any of these conditions I empower my executors to hand over the aforesaid sum of twelve thousand pounds to the Linnean Society of New South Wales to provide a sufficient salary by the year to a competent Bacteriologist who shall be called the Bacteriologist to the Linnean Society and whose duties shall be to conduct original research in the Laboratory of the Society and to give instruction to one or two pupils at the discretion and under the orders and control of the Council of the Society any surplus to be applied to laboratory requirements."

Thus it will be seen that the Council is left with discretionary powers in fixing both the amount of the Bacteriologist's salary, and the date of his appointment. In determining the first of these points, the Council has had to be guided by the

amount of the annual income which the principal may be expected to yield. Now this, in consequence of the serious depreciation in value of all sound income-producing investments which has become so marked a feature in our commercial life since Sir William made his will (in December, 1890), is, I regret to say, likely to be for some years to come a sum considerably smaller in amount than Sir William contemplated would be available for the purpose.

Then as regards the date of the appointment. Since without a suitably equipped laboratory the Bacteriologist cannot carry on the work he is specially to be appointed to do, it is evident that the arrangements for providing the former must progress something like *pari passu* with any scheme for filling the post of Bacteriologist. Before any research can be entered upon, provision must therefore be made for an initial expenditure of something like £700 for equipment and incidental preliminary expenses—or more than one year's income. The necessity for proceeding slowly and with caution led to the Council's appointing a sub-committee to consider generally and report on the best way to give effect to Sir William Macleay's wishes. On presentation of this report it was carefully considered by the Council, and with some slight modifications it was adopted. The result is that the Council has decided that, provided a suitable investment can be met with at a rate of interest not lower than the then current rates, the appointment might be made so as to take effect at the close of the hot season of 1896-97, provided also that a competent Bacteriologist can be engaged on what are practically the terms and emoluments offered to University Demonstrators.

Besides a further postponement of say one year, two, or even three years should circumstances seem to demand it, there is yet another alternative, namely, to make an indefinite postponement with a view to a very substantial accumulation of interest to be added to principal. Against this course it may be urged that on general grounds it is desirable that as soon as circumstances permit the appointment of a Bacteriologist should be proceeded with;

and that already nearly four years have elapsed since the principal became available. And while on the one hand the Council does not expect to attract an eminent European Bacteriologist to the Colonies—nor could Sir William have contemplated such a contingency; yet on the other hand the Council is not altogether without hope that it is possible to find a thoroughly competent and enthusiastic Bacteriologist, animated with the true scientific spirit, who will appreciate the prospect of carrying on original investigations under very favourable circumstances.

With satisfaction may be noted the pleasing evolutionary development in the scope of the Society's scientific work. At the outset this was exclusively zoological. In the Second Annual Address of the first President (Sir William Macleay) the hope was expressed that at no distant date contributions from botanists and geologists would find a place in the Proceedings. Sir William lived to see that hope amply fulfilled. Animal morphology also has become an important feature of the Proceedings. One would be glad to see the morphology of plants commanding a portion of the attention it deserves, but the outlook is not a promising one in that direction anywhere in Australia. The subject apart from that of Bacteriology, languishes at present for want of students for the conditions for their encouragement here are wanting. It would be well if we had even a small edition of such a botanical laboratory as that at the Botanical Gardens at Buitenzorg, Java, so ably presided over by Dr. Treub, and so liberally provided for by the Dutch Government.

Since the last Annual Meeting our numbers have been diminished by the deaths of one Honorary and three Ordinary Members. Professor Sven Lovén, the eminent Swedish naturalist, died on September 6th last at the advanced age of 87. Since 1841 he had filled the appointments of Professor and Conservator of the Royal Museum of Natural History, Stockholm. He devoted much study to the marine fauna of the Baltic and the North Seas, special attention being given to Echinoderms. Professor Lovén was elected an Honorary Member of this Society in 1891.

Of the Ordinary Members, two—Dr. Paul Howard MacGillivray and Mr. J. Bracebridge Wilson—were resident in Victoria. They have strong claims to be held in grateful remembrance by Australian naturalists. Dr. MacGillivray belonged to a family of naturalists. His father was Professor of Natural History at King's College, Aberdeen, and his brother, the late John MacGillivray, was author of the "Voyage of the Rattlesnake." Since 1857 Dr. MacGillivray had followed the practice of his profession in Victoria, at the same time showing himself a public-spirited citizen much interested in the spread of knowledge and culture. Much of his leisure for many years was devoted to the study of Australian Polyzoa, and he was the author of an important series of papers thereon, contributed to the Proceedings and Transactions of the Royal Society of Victoria, or to Professor McCoy's Decades. These date from the year 1859. His important "Monograph on the Tertiary Polyzoa of Victoria" was passing through the press at the time of his death, and has since been published.

Mr. J. Bracebridge Wilson, M.A., F.L.S., who died on October 22, aged 67, was for many years Head Master of the Church of England Grammar School, Geelong. Like Dr. MacGillivray, he was a busy professional man, whose leisure was given up to Natural Science, out of pure love for it. In utilising his yacht in dredging and trawling he found his hobby. This was done in a scientific systematic way, with the object of accumulating stores of well-preserved material for the elucidation of the marine fauna of Port Phillip by specialists, he himself sharing in this part of the work as far as opportunity served.

Nearer home we have lost, at the early age of 30, one of the younger school of naturalists—Arthur Sidney Olliff, who died December 29th last. Mr. Olliff came to New South Wales in February, 1885, to take up the work of Assistant Zoologist, in the Division of Entomology, at the Australian Museum, where he remained until his appointment as Entomologist to the Department of Agriculture, Sydney in 1890. He had been for some time in enfeebled health, and shortly before his

death he had in contemplation a visit to England in the hope of benefiting by the change. Many of his papers on Lepidoptera and Coleoptera will be found in our Proceedings. An appreciative notice by one of his colleagues, together with a complete list of Mr. Olliff's papers, has appeared in the *Agricultural Gazette*, Vol. vii. Part 1 (Jan. 1896).

The year 1895 is especially memorable by the deaths of Huxley and Pasteur, two of the foremost leaders in Science. They occupied so prominent a position in the scientific world that their loss has been truly felt to be of world-wide importance. In the Journals and Magazines of the countries on both sides of the Atlantic have been published numerous well-merited eulogies of their lives and work, written from very varied standpoints, and in many cases based upon special or personal knowledge. As they are within reach, and have probably already come under your notice, I should be at a disadvantage in any attempt to touch further upon themes which have already evoked sympathetic and appreciative treatment from those best qualified to speak.

I propose now to say a few words on the subject of Forestry—the importance of which is much underrated.

Our forests have been left hitherto very much to themselves, the idea being that as Nature has looked after them in the past so a kind providence will continue to do so in the future. The fact is overlooked, however, that with new conditions of settlement the chances of shapely young trees growing up to replace those removed are reduced to a minimum; and so, as has occurred in other countries, the depletion will go on till sooner or later a feeling of alarm arises and the necessity for commencing the work of afforestation is recognised, and the task has to be undertaken at a much greater cost than if time had not been lost.

The ignorance of the benefits to be derived from proper management of the forests is very remarkable. We are possessed of timber which in strength and durability can vie with the products of all the world, and a large revenue could be made out of it. Forestry is, as has been happily said by Professor Bailey Balfour,

a division of rural economy which ought to be the basis of a large national industry.

It is under this aspect that we have chiefly to consider it, and though we may look upon the conservation of our forests with respect to their influence upon health and climate, and upon the soil itself, we are perhaps still more interested in them as a possible source of direct commercial profit on account of the valuable material they furnish.

On the other hand we must not forget that they confer an indirect benefit by protecting the soil and altering the conditions of temperature.

Much lasting injury is done to forests by allowing the pasturing of sheep and cattle in them. Young seedlings which should take the place of those cut down are trampled, browsed down or otherwise so bruised and injured as to be worthless.

Firing of the undergrowth is an evil which is much misunderstood. It is often done by settlers to promote the growth of grass; the fire spreads outside the limits of their land, and much devastation follows. The immediate effect is not only to destroy the promising young growth, but also to char the humus and spoil the fertility of the soil.

It will be well to consider shortly the climatic and hygienic influence of forests. For those who wish to investigate the matter in some detail, I would recommend the perusal of a pamphlet published by the Forestry Division of the United States Department of Agriculture in 1893, entitled "Forest Influences." We have here a series of reports on the different branches of the subject, and there is an able summary of the whole case by Mr. B. E. Fernow, Director of Forestry. As the results are undoubtedly applicable to a considerable portion of this colony, I will refer to them in some detail.

Two classes of effects are to be noticed—namely, those on the general climate and those on the local climate. When we build a house we alter the temperature and humidity conditions of the space covered, and so it is with forest cover, but the question

arises can we alter the conditions on a larger scale by alternating forest and field, or by preserving intact large areas of forest?

In reply to this query, it seems to have been shown by the forest planting at Lintzel that a considerable change in the meteorological conditions resulted.

Forest cover causes obstruction to the winds and hinders the action of the sun's rays upon the soil. A difference in temperature and evaporation outside and inside the forest area then arises. When the areas of the different kinds are large enough, local currents of air will be set up, which will cause the interchange of conditions between the two areas. The size and character of the forest growth, density, height, situation and composition are the factors which determine its influence. It is not trees but masses of foliage that do the work.

On water supply the effect of forest is undoubted. The soil acts as a sponge from which the water runs off gradually; remove the forest wholesale, and the water rushes along, tearing away soil and flooding and injuring growing crops.

Irrigation is generally advocated for arid regions alone, but it is also particularly serviceable in well watered regions, and here, as above shown, forest cover materially assists.

The following observations are of interest:—

First, as to the difference of conditions within and without the forest. On the average the forest is cooler than the open country in summer, but about the same in winter, with a warming effect in spring, and the evaporation is only one-half that in the open.

The percentage of rainfall evaporated is about 40% in the open and about 12% in the forest, taking the whole year.

The total quantity of moisture returned into the atmosphere from a forest by transpiration and evaporation from the trees and the soil is about 75% of the precipitation; other forms of vegetation give from 70 to 90%; bare soil gives only 30%. Gauges in European forests catch 75 to 85% of the rainfall, the rest runs down the trees, is intercepted or evaporated.

The experience of increased rainfall over the station at Lintzel with increase of forest area points strongly towards interdependence.

Secondly, as to the influence of forests upon the climate of the surrounding country.

Any effects that arise must either take place by diffusion or by means of local air currents, or from the fact of the forest acting as a windbreak.

Deforestation allows of the uninterrupted sweep of winds over the country, the evaporating and parching effects being much more intense than those resulting from mere dryness of the air. This class of effect is, of course, worse in flat country and on the seashore.

When moisture-laden winds pass over cool areas of forest the possibility of condensation is at least not reduced, whereas heated plains certainly do reduce it. The presence of large forests in Asiatic and European Russia has been shown to produce a sensible effect in lowering temperature.

In general we may expect that an alternation of large forested and unforested areas in regions which on account of their geographical situation have a dry and rigorous climate is more beneficial than large uninterrupted forest areas which would fail to set up that local circulation which is brought about by difference of temperature and permits an exchange of the forest climate to the neighbourhood.

The results of systematic observations in forest meteorology made in France, Germany, Sweden, Austria and elsewhere, and extensive observations on temperature and rainfall extending to Russia and India are given in the Report.

It seems scarcely necessary to mention the sanitary effect of forests. As is well known, trees have been planted with success to absorb the moisture of swamps, and the exhalations of eucalypt trees are particularly beneficial in counteracting malaria.

The idea that our forests may get exhausted is often jeered at, and figures have been brought forward to show what an enormous and practically inexhaustible supply of timber exists; yet in other

countries with still larger supplies a panic has arisen. The more rapid depletion of our forests for purposes of export is constantly being urged as if we had there, without any trouble on our part, an unfailing source of revenue. By all means let us export, but let us first take steps to replace what is taken away and insure the future.

Some months ago, as the result of a communication which I addressed to the Minister for Works protesting against the exportation of ironbark, a return was prepared by the Forest Branch purporting to show that the forests of this colony would supply over $167\frac{1}{2}$ millions of sleepers, which sounds like an enormous quantity. An examination of the return shows that two-thirds of this quantity is to be obtained from the forest reserves in the Casino and Glen Innes districts, that of the former being reported to cover about 4000 square miles and the other 2000 square miles. Those estimates seem large, and it is curious to note that when the Glen Innes-Tenterfield railway was being constructed the prices paid for stringy bark sleepers was 6s. 6d., while 7s. each was paid for ironbark. This does not look like an abundant supply. It is one thing to have trees scattered through a forest, and another to get them out at reasonable cost.

Assume, however, for the moment that the above quantity of sleepers is obtainable, and that instead of many of them being locked up in almost impenetrable gullies they are obtainable at a small cost, what is likely to be the future demand? Our own requirements for sleepers are at the rate of 2400 per mile, and 1000 miles would only require about 2,400,000 sleepers, but all Australians must hope that with the development of the country, many thousand miles of new lines will be required, and then we have to provide for renewals. Now suppose in addition to our own requirements we foster trade with other countries. In the United States of America there are 180,000 miles of railway. They put their sleepers much closer together than we do, so that they require 3000 to the mile at least. The timber used at present is pine or white oak, the best of which only lasts ten or twelve years. What, if our American friends were really to take

a fancy to ironbark, could we supply their wants? The number required to fit up all the lines would be—say, 540 millions, so that we should only have a third of that quantity, neglecting our own requirements. England and Europe, too, possess an enormous mileage, and might come upon us for supplies; but, as is seen, we simply could not meet them. Then what right have we to talk about encouraging a large export trade until we take steps to increase the natural productiveness of our forests?

In another State Report of the United States Department of Agriculture—namely, that on the “Forest Conditions of the Rocky Mountains, 1889”—there is a paper by Dr. E. J. Janus, which is remarkable as bearing upon the question of the value of forest culture which is so much neglected or ignored. It is scarcely necessary to remark that the Rocky Mountains are the home of some of the principal mining industries in the United States, and are in the centre of an arid region which, except for the streams arising from the melting of the snow on the heights, has little water to depend upon. Therefore, Dr. Janus’ observations, which are made with special reference to this region, are particularly worth attention:—

“The forests of any large country bear a peculiar relation to material prosperity. They not only constitute a large proportion of the national wealth of a nation, but they form the independent basis of a flourishing agricultural, manufacturing and commercial industry. They are, moreover, one of the most important elements in determining the climatic condition of any given region, and through these the distribution of population, of industrial pursuits and of disease and health.” He goes on to say that “the value of the forests is greater than all the metals, coal, petroleum, stone, and all the steamboats, vessels, &c., plying in American waters and belonging to citizens of the United States.” He complains that practically nothing is done to protect or to cultivate, a statement which equally applies to this country, and yet three-quarters of the population use wood as a fuel. In the Australian bush there is at present an apparently unlimited supply of fuel, yet the scarcity of it in the neighbourhood of the larger towns

and centres of industry like Cobar and other mining districts is already painfully felt.

There is an impression that forestry does not pay. There is certainly no greater mistake. The experiences of other countries prove it. I find that in 1884 in Baden the area of the State forests was 234,000 acres, producing a net return of £120,000 annually; in Württemberg the area was 476,000 acres, and the profit derived was £237,400; while in Saxony, with a forest area of 408,000 acres, the net return was as high as £330,000. Perhaps some might argue that although forests would pay in Europe, under the different conditions prevailing here they would not; but a little consideration will show that the conclusion is not warranted. If our hardwood trees grow more slowly—which is, however, not the case, at least on the coast—the produce is of higher value; and in the interior, where from lack of moisture they do grow slowly, the rental value of land is much lower. It can, I think, be easily shown that forest cultivation on areas which do not furnish abundant grass or herbage would produce at least five times as much income from timber as from grazing. Of course the Government would have to keep control of the timber, and not merely for a small fee give a man a license to destroy or cart away as much as he likes.

Professor Bailey Balfour, in his Address to the Biological Section of the British Association in 1894, gives an interesting example of a piece of ground at Nover in Rossshire, which was worth from one to two shillings grazing rent. This land was planted with trees, and after 61 years of growth was clean cut in 1883. The net yield of the land over this period was equal to an annual revenue of nine shillings per acre per annum.

There are cases given in the United States Reports of worn-out sandy land being planted with trees and yielding a profit of twelve shillings and sixpence per acre per annum when cut for fencing posts.

Forest conservation means not that no trees shall be cut down, but that the forests shall be cultivated as any other crop, and not wasted. Steps should be taken to prevent the spread of fire

and the browsing of animals of all sorts on growing forests. This is of the utmost importance.

The matter is one generally for the State to take up, yet there are immense tracts under private control which would pay better as forest than as grazing land, and if proper instructions could be given, suitable schools of forestry instituted, men could be trained both for the employment of the State and to assist private owners. Land owners would be taught to see that it is in the interests of their property to plant and conserve, for the existence of young plantations even, which only their followers will reap the full benefit of, will mark the growth of, to them, an important asset.

In many parts of Europe the organisation for the control of the forests is most excellent. Perhaps of all countries Switzerland is the most advanced. The Reports of United States Consuls, 1887, give some most valuable and interesting information under this head.

Forestry is not only a matter of vital interest as to poor lands, but the reclamation of waste lands can be made profitable. I find it mentioned in another United States Report that in 1885 there were 10,000 acres of thriving forest on Cape Cod planted 30 years before on sterile sands, and extensive woodlands similarly planted at Wood's Hill ; on the other hand, other places that have been denuded have become barren.

On the shores of the Bay of Biscay dunes once stretched over a hundred miles in extent. Sands were driven up the slopes, forming dunes from 100 to 300 feet above the limit of the sea, and moving inland they carried great desolation. Bremontier, a century ago, persuaded the French Government to allow him to experiment, and now there are over 100,000 acres planted with maritime pine, blocking the sea out. The land at the back which was formerly useless is now cultivated, and not only are the hygienic results most remarkable, but the French Government derives a revenue of 180,000 francs from the timber.

In connection with this subject I have endeavoured to obtain some data as to the rate of growth of trees, and the period at which maturity is reached in Australia as compared with Europe. In Europe numerous observations have been made which are given in the above-mentioned Consular Reports. It is stated that trees are allowed to grow as follows :—

Red beech	...	...	...	...	120 years
Oak	...	...	...	...	160 „
Elm, ash and maple	...	...	...	...	80 „
Birches and alders	...	...	...	...	60 „
Other species	..	...	...	...	40 „
White fir	...	...	...	...	100 „
Pine and fir	...	...	...	...	80 „
Larch	...	...	...	...	60 „

Growth in height and girth is most rapid up to 40 or 50 years, after which the rate declines. The increase in bulk, however, proceeds at an increasing rate, as might be expected, seeing that the roots are constantly spreading.

It is much to be wished that systematic observations on the growth of trees, native and exotic, should be made in Australia; but it would appear from the information obtainable that it is, under fairly favourable circumstances, at least equal to that in Europe.

The late Rev. J. E. Tenison-Woods* thought “that the tallest trees of the forest, the giant timber of Tasmania, range from fifty to seventy-five years old.”

The late Rev. Dr. Woolls† says “whatever may be the ages of the Tasmanian Eucalypts, I believe that the harder woods in the County of Cumberland are slow in growth, and that centuries elapse before they reach their full proportions.”

* “Tasmanian Forests.” Journ. and Proc. Roy. Soc. N.S.W. 1878. xii. p. 22.

† Proc. Linn. Soc. N.S.W. 1880. v. pp. 508-509. See also the same author's “Contribution to the Flora of Australia” (1867), pp. 220-221; and “Lectures on the Vegetable Kingdom” (1879), p. 93.

This does not quite agree with my own observations.

Both in the "Eucalyptographia" and in the "Select Extra-Tropical Plants" (Ninth Edition, 1895), Baron von Mueller has supplemented his own experiences with a considerable amount of information from other sources. The Baron considers that *E. globulus* "is, among evergreen trees, of unparalleled rapid growth." And of *E. amygdalina* he says that "plants grown on rather barren ground near Melbourne have shown nearly the same amazing rapidity of growth as those of *E. globulus*." The following instances relating to extra-Australian localities are selected from a large number quoted by the Baron:—In eight years in the south of France *E. amygdalina* attained a height of 50 feet. *E. globulus* in Jamaica attained a height of 60 feet in seven years; in California 60 feet in eleven years; in Florida 40 feet in four years (stem-diameter 1 foot); in the Neilgherry Hills 30 feet in four years (one tree, twelve years old, being 100 feet high, and 6 feet in girth, at 3 feet from the ground). Near Pretoria the same species "attained a stem-circumference of $9\frac{1}{2}$ feet in 22 years"; and "in Algeria and Portugal it has furnished railway sleepers in eight years, and telegraph-poles in ten years."

Mr. H. C. Russell, F.R.S., the Government Astronomer, supplied some particulars in some notes read before the Royal Society of N.S. Wales in 1891, and these he has kindly supplemented with later information.

The trees measured were Eucalypts, growing at Mt. Victoria, and Lake George, and others planted in Observatory Park.

At Lake George one of four young trees was selected for measurement in January, 1885, when its girth three feet from the ground was found to be 23 inches. On 10th November, 1891, its girth was $52\frac{1}{4}$ inches; on 22nd November, 1892, it was $54\frac{1}{4}$ inches; on 1st January, 1894, $60\frac{1}{4}$ inches; and in January, 1895, $63\frac{1}{4}$ inches.

Other trees have been marked since the notes above-mentioned were made, and the results will be watched with interest. At Mt. Victoria on barren ground, about fifty years after Sir T. Mitchell had cleared one of the hills for survey purposes, the trees

were found to have grown up again, attaining a diameter of 15-20 inches; after fifty years' growth the girth was about 63 inches. In Observatory Park specimens of *Eucalyptus globulus* grew to 41½-46 inches in circumference in 16 years. Some examples of *Pinus insignis* of the same age were measured in November, 1891, and were found to be from 31½ to 35½ inches in circumference 3 feet from the ground. The situation, however, Mr. Russell says, does not suit this species of tree, so that of course under favourable circumstances the growth would have been much greater.

I have obtained from Mr. Bray, Police Magistrate of Murwillumbah, who has had long and valuable experience in the "bush," some particulars as to the growth of red cedar, *Cedrela australis*, and other trees. He says, writing to Mr. Caswell:—"I have seen a cedar sapling about one foot in diameter and, I should say, 3 or 4 years old, grow into a tree 3 feet in diameter (20 feet from the ground) in 17 years." "It is very hard to tell when a tree has matured, but from what I have seen of different trees, I should say that most of the 'scrub' trees would grow into good timber and to full size in 25 years." As to the number growing per acre, he adds, "I once felled 38 cedar trees on one acre of land; all these were large trees, none less than 3 feet in diameter, 20 feet from the ground. This was up near Tyalgum." "Some of the very large cedar trees that I have seen here must have been very old—perhaps 100 years."

Mr. Gill, Conservator of Forests at Adelaide, found poplar, pine and oak grown at the Botanic Gardens, Adelaide, to be of good convertible size after 30 years. At Mount Gambier *Pinus insignis*, after 30 years, fetched fifty shillings. Mr. Gill is of opinion that whereas trees in Europe take 60 to 120 years to mature, they will take only half that time in Australia. Specimens of *Eucalyptus globulus*, after 17 and 18 years, produced telegraph poles 25 feet long, each from 8 to 10 cubic feet in measurement. The trees were from 50 to 60 feet high. *E. corynocalyx* (sugar gum) grew after 14 years to a height of 68 feet—a bottom log 12 feet long, containing 11 cubic feet, was cut

out. The timber of this species is now accepted as teredo-resisting, and is being largely planted under Mr. Gill's directions. Mr. Gill says :—"To give you some little idea as to size of timber grown within 20 years, I may state that poles lately cut by me for telegraph purposes, and disposed of to the Telegraph Department, measured 26 feet 6 inches long, and were 7 in. to 8 in. top diameter, and 11 in. to 14 in. bottom diameter. They contained from 8 and 9 to 17 and 18 cubic feet of timber, and this is irrespective of other parts of the tree, which generally totalled from 60 to 70 (or even over) feet in length."

It is apparent from the above that where the climate is favourable the growth of trees is quite sufficiently rapid to justify large expectation of profit. In the interior growth is necessarily much slower, but must still be noticeable. The comparative rate of growth, as compared with trees on the coast, may be assumed to be roughly proportioned to the moisture of the ground, all other things being equal; and it is, therefore, probable that an ironbark in the climate of Dubbo (250 miles from the coast) will take twice as long to grow as the same species where the rainfall is twice as great. Of course this is only surmise, and accurate observations are required.

It is, however, perfectly clear that if on the forest land of the eastern slopes of the main range, where such land might be worth one shilling per acre for grazing purposes, it will pay to grow timber; then in the interior, near the railways, the poor ridges, which are not worth one penny per acre, would if put under cultivation for trees yield a very handsome profit indeed; but it must be understood that this expectation can only be realised if care is taken in growing the trees. They must be started in nurseries, planted out, and, until they have grown to a considerable size, must be properly fenced off and protected from the browsing and ravages of animals and man. Strict measures must also be taken to preserve them from injury or destruction by bush fires.

It is certain that if proper measures were taken a profitable industry could be carried on, giving employment to large numbers

of men. I find that some years ago in Switzerland, where, as above stated, the State management yields a large revenue, there were employed on the forests 5,851 persons, including 150 trained forestry officials and from 1,500 to 2,000 foresters and overseers, the area of forest being 1,940,659 acres.

It is impossible to exaggerate the importance of this subject, and it is to be hoped that with the assistance of the able officers which the Government have at their service some really energetic steps may be taken.

I gather from reports kindly furnished to me from Mr. Gill that in South Australia the area inclosed for planting operations was, on the 30th June, 1894, 11,425 acres, and that during the year following that date an additional area of 320 acres was added. This is a good start for a colony where indigenous timber of value is scarce, and I sincerely wish success to Mr. Gill's efforts.

In order to prove what a hold this question has already obtained upon the practical commercial mind in America, I quote the following from the Century Magazine of September last:—

“During the present year the advocates of a modern forest policy have received the important support of the two leading mercantile organisations of New York City. On January 3rd, 1895, the New York Chamber of Commerce, after special consideration of the subject, adopted unanimously the following resolutions:—

Whereas, A thorough inquiry into the question of the preservation of our forest lands is of permanent importance to agricultural and other interests, thereupon be it

Resolved, That this Chamber recommend to the United States Senate and House of Representatives in Congress assembled, to pass a Bill which authorises the President of the United States to appoint a Commission of three experts and make the necessary appropriation for the purpose or a thorough study of our public timber lands, so as to determine what portions ought to be preserved in the interest of the people, to prepare a plan for their management, and report the same within a year of their appointment. The Commission to have access to all public documents bearing on the subject.

On June 12th, 1895, a similar meeting was held by the New York Board of Trade and Transportation, and after discussion of the larger aspects of the subject the following resolutions were unanimously adopted :—

Whereas, The welfare and the commercial interests of the entire country are closely related to the preservation and proper management of the public forests.

Resolved, That as a first step to a permanent and scientific forest policy, we heartily favour the creation by Congress of a National Forest Commission with the following objects :—

1. To study the public timber lands, reserves and parks, on the ground.
2. To ascertain their condition and extent.
3. To ascertain their relation to the public welfare and to existing local needs of the people as regards agricultural and the supply of wood for mining, transportation and other purposes.
4. To ascertain what portions of the public timber lands should remain as such in view of the agricultural, mining, lumbering and other interests of the people.
5. To prepare a plan for the general management of the public timber lands in accordance with the principles of forestry.
6. To recommend the necessary legislation ; and

Resolved, That the Special Committee on Forestry be directed to communicate with other commercial bodies and with Congress in furtherance of concerted action on this important question at the next session."

The study of the fossil remains of plant life of past ages in this country has of late years received some attention. Professor Ettingshausen, of Graz, has had the lion's share in this work, and as he has expressed views as to the origin of the vegetation of Australia, and of the rest of the world, which appear to be entirely erroneous, and as they appear to be tacitly accepted by Professor Tate in his Inaugural Address to the Adelaide meeting of the Australasian Association for the Advancement of Science, I desire to say some words on the subject, in the hope that some of our New South Wales Botanists and Palæontologists may take the matter up and corroborate or disprove the deductions which, in my opinion, can be made.

Generally speaking, Professor Ettingshausen's theories amount to this, that in Tertiary times, or earlier, there was a universal flora of mixed types, which later on, through the influence of floral climates, became sorted out, so that at the present day distinct regions present distinct peculiarities which at first did not exist.

That the Australian region has now a flora of its own more marked and peculiar than perhaps that of any other region of the earth's surface will be disputed by none. At first sight this circumstance seems to have a parallel in the existence of types of land mammals, stragglers only of which are to be found elsewhere, and this view is apparently strengthened by the fact that in past ages monotremata and marsupials lived in Europe, while, according to Unger, Heer, Ettingshausen, and a few others, Australian types of plants, Eucalypts, Proteaceæ, Casuarineæ, and many others also flourished.

The subject is one well worth careful investigation.

The monotremata we know first made their appearance in the Northern Hemisphere in the Triassic Age, and marsupials of low type are first found in the beds of the Oolitic (Jurassic) Series. In the rest of the Mesozoic series no animals of higher development than marsupials have been discovered, but no sooner do we reach the Eocene than it is evident that an enormous advance has been made, for we find ourselves surrounded with animals of much higher type, including the reputed ancestors of the horse, deer, antelope, squirrel, hedgehog, bear and others. Many remarkable animals existed also of types that have long died out. Searching upwards through the Oligocene, Miocene, and Pliocene, and continuing into the Pleistocene we find, as the meaning of those names implies, more and more resemblance to the animals now living outside the Australian region, while at the same time we still keep sight of a few marsupials having affinities to the American opossum. This progression of types is utterly wanting so far as has been discovered in Australian strata, and it is only in the Pliocene beds that we first come upon undoubted proof of the existence of



mammals, and then we find all at once an abundance of highly differentiated marsupials with monotremes whose descendants comparatively little changed in type we have around us at the present day. That these highly differentiated Australian types had no representation, so far as is known, outside Australia, except in the extreme south of the American continent, is a fact full of significance.

It would appear then as if at the end of the Mesozoic period before the evolution of the higher orders of mammals took place there must have existed a territory already inhabited by marsupials, which then became cut off from the rest of the land to the north, and that in this land—a portion of the pre-existing Gondwana Land of Suess, or Antarctica of Forbes—the differentiation of the marsupials occurred, and that further this land, which may have been shifting in character, was at the end of the Miocene or beginning of the Pliocene, connected with Tasmania. Mr. C. Hedley's paper on the "Surviving Refugees of Antarctic Lands," read before the Royal Society of New South Wales last year, deserves thoughtful consideration.

I have devoted some space to the above matter because it bears on the question of the origin of Australian Vegetation. It is clear that the peculiar Australian types could not have been immigrants by the same route as the marsupials, or, indeed, immigrants at all, but the above considerations show the great probability of the existence of extensive land surfaces in the Antarctic regions at the end of the Mesozoic and in the earlier Tertiary times; that the connection with more northern lands was of a somewhat fleeting character, and that while it permitted of the passage of one element of the Australia Flora from South America to Tasmania, the succession of these fluctuating land surfaces did not allow of any large migration of Australian types in the opposite direction.

In his "Introduction to the Flora of Tasmania," published in 1860, Hooker sets forth the facts connected with the distribution of plant life in Australia and Antarctic lands. This able work is still the best complete treatise on the subject, and only requires

to be brought up to date by utilising the results of the investigations of Baron F. von Mueller and others to make it of full value at the present day.

Hooker points out that what appears to be the indigenous vegetation, and which is, taking the whole continent together, by far the most important both in numbers and characteristics, has been added to in different ways. The coast strip of the north and east has been subject to an invasion of Indian and Malayan forms. These are quite distinct in character from the true Australian ones, which seem to have had their centre of distribution in the south-west portion of the continent.

Mixed up with the flora of the eastern part of Australia, and especially in the south, is a group of plants from the northern temperate regions, which seem to have forced their march upon Antarctic lands by following down the Andes chain to the extreme point of South America, leaving traces on the way, and thence stepping across by land links, which once existed but have now disappeared, the gaps between that continent and New Zealand and Tasmania. This element of the flora is most largely represented in New Zealand and Tasmania, but has also pushed its way up Eastern Australia, particularly affecting the higher mountain tops as they proceed northward, and we even find representatives on mountains of great elevation in New Guinea, and Borneo*

It is remarkable that among the plants thus introduced into Australia there are 17 European species, most of which occur in Britain.

It is almost needless to remark that the typical Australian types are with few exceptions absent from New Zealand.

Hooker further draws attention to the remarkable similarity in character existing between the vegetation of South Africa and

* Trans. Roy. Soc. Vic. Vol. II. Mueller, "Plants of Owen Stanley Range in British New Guinea."

Trans. Linn. Soc. Botany, Vol. II. Part 2. Dr. Stapf, "Flora of Mt. Kinabalu in North Borneo."

Australia. The principal natural orders and groups, which by their abundance produce this result, are the following :—

Proteaceæ, *Compositæ*, *Iridæ*, *Hæmodoreæ*, *Polygalæ*, *Restiaceæ*, *Ericaceæ* (corresponding in South Africa to *Epacrideæ* in Australia), *Papilionaceæ*, *Rutaceæ*, *Thymeleæ*, *Santalaceæ*, and some others.

This looks like parallelism of development from a common origin.

Below is a list of the more important groups, natural orders, tribes, genera or parts of genera, as the case may be, which serve to make up the peculiar and predominant element of the Australian Flora. The orders *Proteaceæ*, *Ficoideæ* and *Restiaceæ* are markedly South African as well. Outside the Australian region and South Africa some scattered representatives of the groups mentioned are to be found. These have the character of escapees; compared with the allied Australian species, their number is insignificant, and one cannot avoid the conclusion that Australia, or some southern land of which Australia is a remnant, was the origin and home of the various races. It is true that some of the outside representatives of Australian types are now separated by wide gaps of ocean from their congeners, but Wallace, in his "Island Life," has shown how plants can thus cross serious obstacles without the existence of actual land connexion. Some of the wanderers are dwellers near the seashore, and thus always ready, as it were, when the means presents itself, for transport by sea. Some have travelled in the reverse direction to the Indian and Malayan immigrants, while others have reversed the order of march of the European invaders already referred to, and have passed up the Andes.

TYPICAL AUSTRALIAN GROUPS.

DILLENIACEÆ.—Tribe *Hibbertiæ*.

PITTOSPOREÆ.—All genera except *Pittosporum*.

TREMANDREÆ.

RUTACEÆ.—Tribes *Boronieæ* and *Zanthoxyloæ*.

STACKHOUSIÆ.

LEGUMINOSÆ.—Tribe *Podalyriæ*, &c. Phyllodineous section of genus *Acacia*.

HALORAGIÆ.—Genus *Haloragis*.

MYRTACEÆ.—Capsular Group.

FICOIDEÆ.—Genus *Mesembryanthemum* and *Aizoon*.

STYLIDIEÆ.

GOODENOVIEÆ.

EPACRIDEÆ.

MYOPORINEÆ.

LABIATÆ.—Tribe *Prostanthereæ*.

PROTEACEÆ.

THYMELEÆ.

CASUARINEÆ.

ORCHIDEÆ.

JUNCACEÆ.—Tribes *Xeroteæ* and *Xanthorrhææ*.

RESTIACEÆ.

Wallace in his "Island Life," the first edition of which appeared in 1880, gives his views as to the point of origin of the Australian types. He places this in the south-west of Australia and assumes the possibility of extension of the land outside its present limits. The western half of Australia was cut off, he says, from the eastern half by the Lower Cretaceous Sea which ran right through the centre of what is now Australia, from north to south. He accounts for the existence of Eastern Australian forms of the typical vegetation by the assumption that they crossed this barrier in the same way as it is known that plants in course of time find means of leaping gaps of great width. This eastern portion is stated to have been in Cretaceous times of limited extent and to have derived most of its vegetation from the land surfaces to its north and north-west, in fact from the Indo-Malayan region.

Professor Tate in his address to Section D. of the Aust. Assoc. for the Advancement of Science in Sydney, 1887, divides the flora of Australia, as follows :—

I. Immigrant.

- a. Oriental.
- b. Andean.

II. Endemic.

- 1. Euronotian or eastern.
- 2. Autochthonous or western.
- 3. Eremian or central.

He says that between the Euronotian and Autochthonian a barrier always existed ; in Cretaceous times it was to a large extent lacustrine, later on the lakes dried up and the present desert barrier formed.

His conclusions are : (1) that the Australian flora is of high antiquity ; (2) that the Autochthonian constituent was dismembered in Cretaceous times and, (3) that the Euronotian constituent was modified during very early Tertiary times by a primitive cosmopolitan flora.

I do not see much to dispute in the above except the supposed existence of a cosmopolitan flora, which is a mere assumption.

Now let us see what is to be learnt from the study of fossil plants as to the former land surfaces of the southern hemisphere.

In the Australian Coal Measures, which are now acknowledged to be of Permo-Carboniferous age, there is a remarkable absence of the plants which abound in contemporaneous beds of the northern hemisphere, but instead of this we meet with an enormous development of *Glossopteris*, *Gangamopteris*, and other genera of ferns which do not occur in the northern hemisphere till a much later epoch. These forms are found over a very large area of the earth's surface, not only in Australia, but also in India and South Africa, and it has been recently announced that a remarkable affinity with the Australian and Indian Carboniferous fern flora has been traced in Argentina in South America.

Judging from these facts, there is little doubt that in Permo-Carboniferous times an isolated Austral region of vast extent existed.

The discovery just referred to can be best described by quoting from a Note in "Nature," Vol. LII., p. 523 ; and its importance is expressed in an extract from a letter of Mr. W. T. Blandford to the same journal, Vol. LII., p. 595 :—"The latest number of the *Records* of the Geological Survey of India contains a translation of a paper by Dr. F. Kurtz on the Lower Gondwana beds of Argentina (from *Revista del Mus. de la Plata*). In this is recorded an important discovery of plant remains in shales at Bajo de Velis. These fossils are well preserved, and while being quite different from the Argentine plant-remains already found, show a close affinity to the plants of the Kaharbari beds of the Lower Gondwanas of India, as well as to those of the Ekka-Kimberley beds of South Africa, the Newcastle and Bacchus-Marsh beds of Australia and the Mersey beds of Tasmania. The previously known plant-bearing beds of Argentina consisted of two series—one containing a Rhaetic flora, resembling that of the Stormberg (Upper Karoo) beds of South Africa, the Hawkesbury beds of Australia, and the Rajmahal (Upper Gondwana) series of India; the other containing a flora of Lower Carboniferous character. The newly discovered flora must be intermediate in age between those two—that is to say, it cannot be older than Upper Carboniferous, nor younger than Triassic; and with it must go the flora of the important coal-bearing Upper Gondwana beds of India. These have already been assigned to the Upper Carboniferous (at lowest) by Messrs. Medlicott and Blandford, and the Indian Survey, and the new discoveries in Argentina give a satisfactory confirmation of their views."

Writing on this discovery Mr. W. T. Blandford says (see "Nature," LII., p. 595) :—"It is difficult to understand how two floras, differing from each other far more widely than do any two continental floras living on the earth's surface at the present day, can have co-existed, unless there was for a long period of geological time a great southern continent—the Gondwana-land of Suess—

isolated by a wide sea, probably an ocean, from the land that occupied in Carboniferous and Permian days so wide an area in the northern hemisphere. The importance of the new discovery is the immense extension that is given to Gondwana land and the proof it affords that the region with its flora extended to the western hemisphere and included a part at all events of South America. This appears to indicate that a considerable area now occupied by ocean in the southern hemisphere was land in the Carboniferous period. Further research is needed to show whether the various tracts of Gondwana land were connected by a South Polar land area."

A region like the above if of long continuance would form a favourable centre of development for the higher forms of vegetation. We have already indications that Dicotyledons existed in the southern hemisphere at an earlier age than in the northern. Is it not therefore possible that the *Proteaceæ*, at least, which, as Bentham has shown, represent—especially the Tribe *Nucamentaceæ*—a very ancient type, may have here originated? While the connection of this land with South Africa and Australia continued, opportunity would be afforded for the colonisation by *Proteaceæ* of both countries, and the subsequent subsidence of the connecting links would result in the present separation into two divisions of one group of plants. The close alliance of other groups of phanerogams in South Africa and Australia has been already referred to, and there are not wanting botanists who consider that it was in the southern hemisphere that the evolution of the higher orders of plants commenced.

The *Conifereæ* are a very ancient group, and they do not appear to furnish reliable data from which the distribution of land and water in past ages can be deduced. *Conifereæ* make their appearance in Carboniferous times both in the northern and southern hemispheres. *Araucaria* comes into view in the Jurassic Period in the northern hemisphere. The genus is a remarkable instance of persistence of type, a character which also applies to the species. In China remains closely allied to our *Araucaria Cunninghamii* have been found, and in the Bagshot Sands at

Bournemouth in England branchlets and scales have been discovered which are scarcely distinguishable from those of our species abovenamed. Fossil remains of the genus have been found in Europe, North America, China, the extreme south of South America, Tasmania, E. Australia, and even the Island of Kerguelen. Living species occur in North-east Australia and adjacent islands, Chili and Peru.

The genus *Dammara*, the best known example of which is the New Zealand Kauri, now exists in Queensland, New Zealand, Borneo, Celebes and the Philippines. Remains obtained from the Cretaceous rocks of Greenland have been referred to this genus, but the identification is somewhat uncertain.

Araucaria is not typical of any country; and the same may be said of that other ancient group the *Cycadeæ*, which have had a world-wide distribution. It is necessary to draw attention to this, as the fact of their existence in certain strata in the northern hemisphere has assisted in the drawing of false comparisons between the tertiary vegetation and climate of Southern England and those of Australia of the present day.

The first undoubted appearance of Dicotyledons in Europe is in the Upper Cretaceous Beds, and there they are found in large numbers, as if an invasion of those forms after collecting strength elsewhere had just taken place.

The oldest examples of dicotyledonous plant remains in Australia hitherto brought to light are some obtained by Mr. H. C. Stokes about three years ago in some railway cuttings near Brisbane. These fossils were sent by Mr. Etheridge to Baron Ettingshausen, who pronounced them to be of Upper Cretaceous age from a consideration of their character which resembled European specimens from strata of that age. Mr. Etheridge informs me, however, that the beds in question are considered by Mr. R. L. Jack, Government Geologist of Queensland, to form part of the Ipswich Coal Measures, and as such are of Early or Middle Mesozoic age.*

The whole of the facts having reference to the distribution of plants and animals in the southern hemisphere seem to point to

* Geol. & Pal. of Queensland and New Guinea, p. 597.

the existence through long periods of geological time of large areas of land surface, and the discovery of dicotyledonous plant remains in the Ipswich Coal Measures containing types similar to those existing in Australia at the present day and the absence of any such fossils of corresponding age in the northern hemisphere point to the same conclusion. It seems highly probable that we have in store for us a series of most interesting discoveries whereby we may have revealed the primitive types of the Angiosperms and be able to trace at any rate their ancestry some considerable way back.

In the Journal of Botany, 1865, there is a translation by Seemann of a remarkable and sensational address delivered in 1861 by Professor Unger of the University of Vienna to his students, entitled "New Holland in Europe." In this address Unger gives an account of the supposed identity of a portion of the European Eocene flora with the existing flora of Australia. This was the first clear exposition of a theory which has found favour with certain European Botanists, although strongly contested by others.

Wesel and Weber had some years before this written a paper on the vegetable remains from the brown coal of the Rhine, and an abstract will be found in the Quarterly Journal of the Geological Society, Vol. XV. Hooker in a note on this subject in the Introduction to the "Flora of Tasmania" says:—"The Australian genera include *Eucalyptus*, *Casuarina*, *Templetonia*, *Banksia*, *Dryandra* and *Hakea*. I am not prepared to assert that these identifications or the Australian ones of the Mollasse are all so unsatisfactory that the evidence of Australian types in the brown coal and Mollasse should be altogether set aside; but I do consider that not one of the above-named genera is identified at all satisfactorily, and that many of them are not even problematically decided."

Unger begins his address by contrasting life at the present day in Australia with that of Europe, pointing out that in the one you have the lowest types of mammals and the lowest types of man as compared with the highest orders of mammals and the highest civilized man in the other, and then enters into a diatribe against

this "despised, decrepit, or scarcely born fifth quarter of the world" showing I venture to say much ignorance in so doing. He afterwards states that what was begun in Australia was transported to Europe by some supposed land bridge and there destroyed while Australia stood still, and the latter is now being threatened with almost total extinction, like the Pacific Islands. The Australian types represented in Europe were, according to him, Proteaceæ, Epacridæ (through one leaf), Santalaceæ, Coniferæ and other orders. *Araucaria* is especially mentioned as abundant in some of the beds of Europe, and then he argues that the conditions which allow of these types now in Australia must have existed in Europe in Eocene times, and concludes that the climates were similar. He seems ignorant of the fact that *Araucaria Cunninghamii* grows in the humid brushes of the coast region, while *Banksia* and other genera are adapted to flourish under drier continental conditions and poor soil.

Unger requires other bridges for the explanation of his theories and one of them is that by which he supposes the European flora obtained a contingent from America, namely Atlantis.

The opinion that there was an identity of forms in Europe in Tertiary times and Australia of the present day took deep root, and was still held by Heer, and is now by Ettingshausen and others in spite of the fact that other botanists equally distinguished have proved the fallacy of the idea.

Among these latter is Bentham, whose work on the Australian Flora specially entitles him to authority. All Bentham's Presidential Addresses to the Linnean Society are of the highest value, and the one delivered in 1870 in which he specially devotes himself to the subject in hand, should be read by all interested in this subject. In it he ably contests the new views, and referring to Unger's tabular pedigrees of European forest races, he says that his speculations have been deduced much more freely from conjectures than from facts, and he mentions that the great majority of fossil species are established on the authority of detached leaves or fragments of leaves alone. He then points out the unreliability of determination by leaves alone, and how even DeCandolle had

been in error even as to natural orders of specimens of which he possessed leaves alone, and he refers to Professor Flower who had pointed out that leaves belong to a class of structures that are aptly designated adaptive as opposed to essential. He next points out that some of Heer's determinations of *Podogonium* of the Caesalpinaeae where specimens of leaves, fruits, and even flowers, some of them still attached are conclusive, and that from their relation to existing plants point to certain conclusions as to climate ; but in dealing with the reputed Australian groups he is strongly adverse. Speaking of Proteaceae, he says "I have no hesitation in stating that I do not believe that a single specimen has been found that a modern systematic botanist would admit to be Proteaceous unless it had been received from a country where *Proteaceae* were otherwise known to exist." As Mr. Bentham was especially engaged at the time in the examination of Proteaceae, I cannot do better than make one or two short quotations in order to give his own words. "The analysis and detailed descriptions I have had to make within the last few months of between four and six hundred *Proteaceae*, and consequent investigation of their affinities and distribution have shown that the Order, as a whole is one of the most distinct and most clearly defined amongst Phanerogams. I do not know of a single plant intermediate in structure between that and the nearest allied Orders which I cannot say of any other of the large Orders I have worked upon. There is, moreover, especially amongst the *Nucamentaceae* a remarkable definiteness in the majority of genera without intermediate species, whilst the whole Order exhibits the greatest uniformity in some of its most essential characters, derived from the arrangement of the floral organs and the structure of the ovary and embryo, accompanied by a truly protean foliage. All this points in my mind to unity of origin, very great antiquity and long isolation in early times." Speaking of the so-called fruits of *Hakea* and *Embothria* as determined and figured by Ettingshausen but of which the internal structure is not visible, he says that some are "quite as much like those of several *Coniferae*, or of certain genera of *Meliaceae*, *Sapindaceae* and various other Dicotyledonous

orders" and others "have a venation of the wing very different from that of any *Proteaceæ* I have seen, and much more like that of a real samara of an ash." After discussing many examples he says, "From the above considerations I cannot resist the opinion that all presumptive evidence is against European *Proteaceæ*, and that all direct evidence adduced in their favour has broken down on cross-examination; and however much these Eocene leaves many assume a general character which may be more frequent in Australia, (in *Proteaceæ* and other orders) than elsewhere, all that this would prove would be, not any genetic affinity with Australian races, but some similarity of causes producing similarity of adaptive characters."

The above remarks from a botanist so eminent and experienced in questions of the Australian flora as Bentham might well have been thought conclusive, but we find that Ettingshausen in 1890 brought out a work entitled "*Das Australische Florenelement in Europa*" in which he reasserts the existence of *Leptomeria*, *Casuarina*, *Exocarpus*, *Banksia*, *Dryandra*, and *Eucalyptus*.

The subject of fossil plants and their identification is ably treated in the "*Handbuch der Palæontologie*," Part II entitled "*Palæophytologie*." This work as stated on the title page was begun by Herr Schimper, formerly Professor at the University of Strassburg, continued and concluded by Herr Schenk, Professor of Botany at the University of Leipzig, and edited by Professor Zittel of the University of Munich. It was published in 1890.

Doubt is thrown on the identification of *Casuarina*, *Bursaria*, *Hibbertia*, and *Callicoma*. Speaking of the remains attributed to the capsular *Myrtaceæ*, Zittel says there is no necessity to fly to that explanation. As to *Proteaceæ* the conclusion appears to be the same as that of Bentham. The identification of *Leptomeria* is spoken of as being due to superficial resemblance to which weight is given without critical inquiry. I have looked carefully through Zittel's work and I cannot find that the correctness of the identification of any Australian forms is acknowledged except some fossils of the Upper Cretaceous which have been classed and named *Eucalyptus Geinitzii*.

It is to be observed therefore that all resemblances to Australian existing vegetation in the Tertiary flora is looked upon by Hooker, Bentham, Zittel and many others as fanciful and unproved. As regards the supposed *Eucalyptus Geinitzii* it will be noticed that the figure in Zittel's book reminds one of the style of growth of a Eucalypt, but the fruits are by no means like what exist at the present day. It is, however, just possible that here we have something like an ancestral example of the capsular *Myrtaceæ*, or indeed of the whole group of the *Myrtaceæ*, for it may be assumed that the fleshy-fruited section of the order developed by natural selection out of the hard-fruited one—community of type no doubt implies community of origin. There is, however, an element of doubt about the whole matter, as it is strongly to be suspected that the immediate ancestors of *Eucalyptus* in Australia had opposite leaves.

Be that as it may, however, there is nothing to prove that in Tertiary times any of the typical Australian groups existed outside Australia.

Pliocene fossil remains from Victoria have been investigated by Professor McCoy and Baron von Mueller; also specimens from Orange in this colony. The parts described consist of fruits and a few leaves. But Baron von Mueller has, I believe, steadily refused to classify leaves or fragments of leaves, and condemns the practice.

Some fossil plants from Dalton, near Gunning, and Vegetable Creek, in New South Wales, were sent by the late Mr. C. S. Wilkinson, Government Geologist, to Professor Ettingshausen, and they have been examined and reported upon by him. Professor Ettingshausen's two memoirs on the subject have been published in English by the Mines Department of Sydney in one volume, the book being edited by Mr. Robert Etheridge, Junr., now Curator of the Australian Museum.

The fossils consist almost entirely of leaves, and the strata are according to Mr. Wilkinson of Upper Eocene or Lower Miocene age, while those examined by Baron F. von Mueller are of Pliocene age. Mr. Etheridge does not accept any responsibility as to

identification from leaves. Baron Ettingshausen's conclusions are as follows :—He finds 98 species representing Cryptogams, Monocotyledons, Gymnosperms and Dicotyledons; and as he says the most important general result is this :—

“The Tertiary Flora of extra-tropical Australia is, as regards character, essentially different from the present living flora of Australia; nor does it closely resemble, in general, any other living flora. On the other hand, it shows the mixed character of the Tertiary Floras of Europe, the Arctic Regions, North America, and probably all the Tertiary Floras. It has also much more similarity to the Tertiary Floras at present known than to the existing flora of Australia. The characteristic plants of Australia are but feebly represented.”

He finds such genera of the northern hemisphere as *Myrica*, *Betula*, *Alnus*, *Quercus*, *Fagus* and *Salix* represented. Of these we have at the present day *Fagus* only. There are other genera of East Indian origin, which is not to be wondered at, as we have such at the present day; but he also finds species of *Magnolia* allied to North American forms; *Bombax* of tropical America and some Oceanic genera which I think are much more doubtful.

These and other conditions seem to indicate to him an original universal flora in Tertiary times to which all the present existing floras of the earth may be traced back, and the evolution of the present flora from the Tertiary flora took place through the differentiation of the “floral climate”—whatever that may mean—which, however, was effected differently in different parts of the globe. (See History of the Development of the Vegetation of the Earth. Sitzungsber. der Acad. der Wiss. Wien).

As already referred to, further investigation has been made by Baron Ettingshausen as to some fossil plant remains found when excavating some railway cuttings near Brisbane rather more than three years ago. This gentleman made a preliminary investigation of them and submitted a report to the Imperial Academy of Sciences at Vienna on the 13th April, 1893. The presence of many of the Tertiary forms is apparent, and among them

Myrica, *Quercus*, *Fagus*, *Cinnamomum*, *Banksia* and *Eucalyptus* are found to be well represented.

I have not seen these, but I have carefully looked into the matter of the Dalton and Vegetable Creek fossils, and I cannot agree with the crucial determinations of Professor Ettingshausen, and I believe that his conclusions as to the character of the flora and its resemblance to the flora of other parts of the world are utterly wrong.

With the aid of Mr. R. Baker, F.L.S., of the Technological Museum, I have made comparisons between the fossil leaves and living ones, and so far as I have gone I find that the various types of fossil leaves are represented among existing plants and that there is no reason to go outside Australia to look for them. But even supposing the existence of the northern genera in Australian strata could be undoubtedly shown, Ettingshausen's deductions are still not valid, for *Alnus*, *Acer*, *Quercus*, *Myrica*, and others have to-day a wide range which brings them almost into close proximity to the Australian region, while species of *Quercus* have been actually proved to exist to-day in New Guinea, which is in the Australian region.

This portion of my Address has taken up so much time that I cannot on the present occasion do more than refer to one or two instances of what I consider faulty identifications, but I hope that during the ensuing year I may be able to present to the Society some further notes on the subject.

Fig. 1, Plate III., in Ettingshausen's work is named *Cinnamomum Leichhardti*, but the leaf represented is much more like that of *Smilax australis* or a species of *Rhipogonum*. It is not safe to conclude that all leaves with the *Cinnamomum* venation belong to that genus. *Litsaea dealbata*, which grows as far south as latitude 34°, and on Mt. Wilson at an elevation of 3,600 feet, and is not indicative therefore of tropical conditions, has the same venation. Baron Ettingshausen's specimens of *Acer* are much more likely to belong to *Sterculia*. The *Alnus* fruit it has been shown is probably a fragment of an *Araucaria* branchlet,

and the leaves attributed to *Betula* might equally well belong to say *Pomaderris betulina*.

There are many other examples which I have not time to give in detail now, but I have little doubt that all or nearly all the fossil leaves can be shown to possess the form and character of existing ones in the brush forests at the same latitude on the coast, and there is no necessity to search the world over for resemblances.

As to the statement that the Australian types are not proportionately represented, it is only a pity that Baron Ettingshausen is not better acquainted with the Australian flora of the east coast. He would find that in the dense brush forests of the coast Eucalypts and *Proteaceæ* become choked out and their place is taken by other types from the north. It is only necessary to suppose that the vegetation of the coast extended inland as far as Gunning or Vegetable Creek, a circumstance very likely to happen in the moister Miocene times, and one might have leaves preserved not of the open forest or scrub where the Australian types abound, but that of the brushes where the same are rare.

It is clear from the above considerations that the existence of the universal flora of mixed types assumed by Heer and Ettingshausen is not proved and that the extraordinary sorting operation which the "floral climate" was supposed to effect is grossly exaggerated. The absurdity of the supposition with regard to Australia seems to me extreme when it is remembered how many climates (not one alone) varying between hot and cold, moist and dry, Australia possesses. Eucalypts and other trees grow from east to west and from north to south of the country under the most variable conditions, and they will grow in other countries in the greatest luxuriance.

Further investigation of this subject should be persisted in, and the Tertiary and earlier beds of Western Australia may be looked to to throw light on the subject.

At present the facts seem to afford grounds for concluding—

(1) That many, if not all, the typical Australian floral types originated in Australia or in some land connected with it, but now submerged.

(2) That the assumption of the existence of a universal flora of mixed types at any epoch is unfounded.

(3) That the fossil plant remains of Tertiary age in Eastern Australia indicate a vegetation in all respects similar to that existing on the coast in the same latitude at the present day.

To them might perhaps be added a fourth conclusion of less certain character, but of high probability, that the *Proteaceæ* represent a most ancient type which had their origin at a time when not only extensive areas of land existed in the southern hemisphere but when some kind of connection more or less lasting existed between Australia and South Africa.

I take this opportunity of pointing out the danger of forming conclusions as to former climates from the character of vegetable remains. It has been not infrequently assumed that because leaves of *Cinnamomum* or other tropical types are found the climate must have been tropical, although the value of the argument is at the same time nullified by the acknowledged presence of leaves such as *Alnus* and *Betula*, belonging to the cooler temperate regions. The European temperate flora of the present day is very distinct from the tropical—it is cut off from the tropical flora of the same longitude by transverse mountain barriers and the Sahara desert, but on other parts of the earth's surface there does not exist this marked division. On the Pacific Coast of Asia tropical types reach Japan, while temperate types have advanced south into the tropics. Tropical types invade the valleys of the Himalayas, and on our east coast the same intermingling of types occurs. In Tertiary times probably these barriers to the spread of the different types did not exist in Europe and the tropical vegetation of the south or south-east was enabled to invade temperate latitudes as is the case on the eastern coast of Asia at the present day.

I should like to induce Members of our Society to urge upon their friends scattered throughout the country to report any geological or palæontological discoveries which may come under their notice. There are so many interesting facts to be elicited, and the geological record in this country of ours is so broken up

and detached that when information can be obtained it is very precious. It often happens that fossils are found by those who are entirely ignorant of their value, and they are looked upon as fossils and nothing more, as if they were not each of them bits of history to be carefully treasured. If they are carried home they lie about for some time and are eventually lost. Such relics should be carefully preserved, the circumstances and manner of the find in each case noted and reported to the Department of Mines. I am certain that many interesting discoveries are lost to science through neglect or ignorance.

Another work that requires carrying out more fully and over a larger field than at present is the formation of local herbaria, including the forwarding of duplicate specimens to Sydney for identification. The knowledge of the distribution of plants in this country is far from complete, but it is a most interesting and important subject. Ladies residing in the interior, many of whom I know find their time hang heavily on their hands, would earn the gratitude of the scientific world if they would undertake to carry out this object, which would be more an amusement than a toil. Many districts are out of reach of ladies, and must be explored by the sterner sex. Local officers of the Government service should also be expected to assist. The great army of forest rangers, surveyors, road superintendents and others might have this work made part of their duties. Whenever an important commission is sent by the British Government for geographical research into a little known country, for the delimitation of frontiers or other serious work, a man of science is invariably sent to assist in the expedition. In this case as it were we have the new and undiscovered country close at hand. Why should we neglect our opportunities?

The additions to our knowledge of the natural history of Australia directly resulting from the operations of the "Horn Scientific Expedition to Central Australia" promise to be of the greatest interest and importance. Captain Sturt, the pioneer explorer in this region and its outskirts (1844-46), was also the first to furnish some insight into its natural history. In an

appendix to his "Narrative of an Excursion into Central Australia" he enumerates 10 species of Mammals, and 141 species of Birds met with during the course of the expedition. In the botanical appendix in the same work, R. Brown states that the collection of plants comprised about 100 species, though he enumerates but 26, chiefly the new genera and species represented. The discovery of the Alexandrine Parrakeet, and especially of *Notoryctes*, may certainly be allowed to count for a good deal; but otherwise it must be confessed that the supplementary zoological knowledge gained during the half-century which has since elapsed has not amounted to very much; and the progress made compares unfavourably with the advance in other branches, particularly in botany. Not many explorers in later days have failed to come within range of the persuasive influence of Baron von Mueller; and Professor Tate has been indefatigable in his efforts to accumulate natural history data in respect of both Tropical and Extra-Tropical South Australia. Consequently lists of plants with other botanical information will be found in almost every explorer's account of his travels, or in the Transactions of the Royal Society of South Australia. But we may look almost in vain for corresponding contributions to zoological knowledge. This, however, is not altogether a matter for surprise when allowance is made both for the natural advantage which the botanical collector has over his zoological confrère, and for the special difficulties—of collecting and preserving, as well as of transport—which have usually attended the steps of travellers in this part of the Continent, especially before the introduction of camels. Hence beyond the descriptions of a few miscellaneous species, which from time to time have come into the hands of zoologists, almost the only contributions supplementary to the information supplied by Sturt are (1) the lists of the incomplete collections of birds and molluscs obtained by Mr. F. G. Waterhouse; (2) Mr. Sanger's notes on the mammals and a few other forms, specifically undetermined, observed during two years' residence at Cooper's Creek; (3) Dr. Stirling's paper on *Notoryctes*; and (4) the important Reports of the Elder Expedition. This expedition, however, was persistently

attended by dry weather; its circuit took in West Australia, and its single naturalist had to divide his attention between botany and zoology.

There was, therefore, ample scope for a well-organised attempt to throw more light on the natural history of this remarkable tract of Australia. At the Adelaide Meeting of the Australasian Association, Prof. Tate, in his Presidential Address, expressed the earnest hope that "a systematic exploration of some well-known area, such as the MacDonnell Ranges," might become possible on the part of a well-known South Australian patron of exploration "as a crowning effort to unfold some of the mysteries of our dry interior." Not quite in the way Professor Tate had in his mind, but for practical purposes in an equally satisfactory way, through the liberality of Mr. Horn, the attempt was shortly afterwards made. And with what conspicuous success we may judge from the first instalment of the Report of the Expedition—Part ii. Zoology (4to. pp. 1-431, with 22 plates), edited by Professor Baldwin Spencer, recently issued. To this important work some little attention may worthily be devoted.

Leaving out of consideration the Hymenoptera (other than the Honey Ants) and the Hemiptera, the returns for which are not completed, we find that the Horn Expedition has added some 164 new species (Vertebrates 30, Invertebrates 134) to the general fauna of Australia. Taking all things into consideration this is a very substantial gain. Central Australia is not a region which could be expected to yield a varied fauna very rich in species. Some groups, well represented in other parts of Australia, but requiring a more or less humid environment, seem here to be wholly wanting, or but feebly represented.

As a contribution to the fauna of a particular circumscribed area of the Continent—the central portion of the Eremian Region, Larapintine Region as Prof. Tate now proposes to call it—the results are even more important. Again, leaving out of consideration the Hymenoptera (other than the Honey Ants) and the Hemiptera, we find a total of between five and six hundred species (Vertebrates 177, Invertebrates 358) assigned to it. This

at first sight seems a not very large census; and no doubt in time and under very favourable circumstances it will be to some extent increased. Every naturalist who resides for some time even in a good collecting district knows how long a time it takes to arrive at a complete census of the groups of its fauna in which he is especially interested; and how his experiences vary from year to year and from season to season. Still less is it likely that the zoological resources of an enormous area like Central Australia should be exhausted at a single attempt by visiting naturalists almost constantly on the move, however enthusiastic and assiduous they might be. From the experiences of Prof. Spencer we gather that if a zoological collector in Central Australia is to be successful in getting together a collection—not merely of skins of beasts and birds—but one at all representative of the general fauna, questions of time and patience must be of quite secondary importance. First of all he has to catch his animals—but in some seasons, and in the case of some of the most interesting members of the fauna, this is an unusually difficult task, and may entail long and patient waiting upon the rains, as well as securing the cooperation of the Aborigines. Should he arrive in a dry season he might without previous experience even wonder whether, except ants, there were any animals to be caught. The visit of the Horn Expedition was made during the winter months (May-Aug.) after good rains. But during the course of the expedition the rain kept off, the result being that a number of forms were overlooked, and many experiences were missed, and would have been missed altogether, had not Professor Spencer on his own account subsequently made a rapid supplementary journey to Charlotte Waters in time to see some of the more important but transient aspects of the transformation scene which the advent of good rains brings about.

Looking at the Larapintine fauna as a whole, we find it characterised by both negative and positive features. The negative characteristics are shown by the absence of many widely distributed Australian forms, or among the higher groups by the limited number of species of the types which do occur, or by the

complete or almost complete absence of representatives of orders which are abundant in other parts of the continent. This state of things is sufficiently accounted for by the arid nature of the country and its unsuitability for their maintenance, or by the effectual climatic barrier which keeps them out. Thus, it would seem that with the want of suitable perennial rivers and creeks may be correlated the absence of *Platypus*, just as the absence of forests accords with a dearth of arboreal *Phalangers*. Land *Planarians*, *Peripatus*, *Terrestrial Amphipods* and *Isopods*, and *Slugs* are among the other notable absentees (as well as *Myriopods*—possibly an unintentional omission).

Earthworms are poorly represented, only one species having been found. This—a species of *Acanthodrilus*—is a treasure which in quality compensates for some of the deficiency in quantity. It is a good instance of discontinuous distribution, and furnishes Professor Spencer with an opening for some interesting speculations. The genus is one which in Australia has lost ground, being at present but feebly represented in a few widely separated localities. Formerly when the rainfall was greater it was probably the dominant genus in the northern portion of the Continent, as it still is in New Zealand and elsewhere in the Southern Hemisphere.

Butterflies and *Lepidoptera* generally are not numerous represented. But the collection was made during the winter months, or rather during a dry spell, which will perhaps to some extent account for the scarcity.

The positive characters are shown chiefly in this—that the Larapintine fauna is a select assemblage of species which may perhaps be roughly classified as very hardy species, and as species which in habit or in structure have become specially adapted to live in an arid region, or which have been able to take advantage of some favourable external circumstances.

Some of them doubtless are the lineal descendants of forms which have uninterruptedly inhabited the region from a time antecedent to the setting in of the Dry Period, which proved so disastrous a change to forms like the *Diprotodon*. Others are

immigrants from very various directions. The new light thrown upon these matters by the naturalists of the Horn Expedition is one of the distinctive features of the Report. We get as it were hints and glimpses of adaptive relations to special surroundings in studying the fauna of the inland portions of the eastern colonies, but in Central Australia they reach a maximum. Here the struggle for existence takes on a new aspect. It is on the whole perhaps not so much a struggle among individuals as a struggle against climate, and all that that involves. As Darwin says: "When we reach the Arctic regions, or snow-capped summits, or absolute deserts the struggle for life is almost exclusively with the elements" (Origin, 1st Ed. p. 69). In Central Australia when a really good time comes, though some species have their numbers kept down by predaceous enemies or by a percentage of their progeny failing to complete their development in time, it must, though short, still on the whole be a very good time for a considerable proportion of the fauna.

When the drying-up process sets in again, then once more begins the struggle against the elements, and the need for special adaptation comes into play. The larger mammals endowed with great vitality, such as the kangaroo and the dingo, must weather it out or travel. The smaller mammals are nocturnal in their habits, often burrowers, able to put up with a minimum water supply, and a diet of ants or of dry herbage. The frogs are especially interesting as having in most cases superadded to a strongly marked burrowing habit a remarkable capacity for storing water within their bodies. The fishes are favoured in another way. In South Australia, Victoria, and Tasmania is found the pouched lamprey (*Geotria*) which in dry seasons is said to fill its remarkably developed throat-pouch with water, and then to aestivate buried in the mud. Of the Central Australian fishes Mr. Zietz is unable to report anything so striking as this. The piscine inhabitants of isolated shallow pools become extinct in dry periods, but others survive in the deeper permanent holes whence they may be afterwards again distributed by floods. Like the Batrachia, too, they have another string to their bow in the

possible dispersion of their ova through the agency of aquatic birds. Of the fluviatile Mollusca Mr. Sanger says that the *Unios* æstivate in the mud; that the gasteropods (five species) die when the creeks dry up, but that each flood stocks the creeks again, young ones in all stages of growth being met with in the flood waters. Some of the land mollusca are remnants which have found a haven of refuge of restricted area "on the southern escarpments of the elevated land or in the deeply shadowed gorges of the same," forming single colonies, or if more then widely separated. The Crustaceans are either burrowers like *Astacopsis* or *Telphusa*, or they are Entomostracans which like *Apus* develop only after their eggs have been dried up. The Honey Ants have learned to store up honey in a remarkable way, certain workers being set apart as receptacles for the honey collected by the other workers of the community.

An elaborate series of observations extending over several successive meteorological cycles—if such were possible—would probably show a considerable corresponding ebb and flow both in regard to species and to individuals. In times of unusually prolonged and trying drought, the fauna in spite of the assumption of adaptive characters must still suffer severely; and recovery only become possible by a succession of very good seasons leading to increased fertility on the part of the survivors, or providing for the influx and establishment of immigrants.

Thus the Larapintine region furnishes an Australian phase of a state of things analogous to what obtains in arid regions in other parts of the world. In keeping with the characteristic and paramount claims of humidity, the call is for animals pre-eminently endowed with æstivating capabilities. In Central Australia in winter the winds are cold, and the nights frosty; but allowing for all this it is still a land of sunshine. It may even be called a land of perpetual summer by contrast with some parts of North America, of which Merriam says that the cold in winter is so intense that it is quite a common occurrence for trees five or six feet in diameter to be frozen to the heart. In so far as hibernation is due to the influence of intense

and prolonged cold, Central Australia makes but trivial demands upon its inhabitants in this direction. The power to withstand the effects of prolonged droughts—not merely to enter upon a “summer sleep” induced by high temperatures—in a high degree seems to be the all-important thing.

Respecting the most characteristic Eremian species a few points may be noted. Among the Mammals, *Notoryctes*, that curious marsupial modified for a burrowing habit, is pre-eminent. *Chaetocercus* hitherto known only from a unique made-up skin, and from a locality not entirely above suspicion, now appears as a new creature. The new genus *Dasyuroides* is an important addition to the fauna. Very important are Professor Spencer's interesting observations on the indications presented by some of the smaller marsupials of a diminution in the number of young produced at a birth; and also of the irregularity in their attainment of full growth due to the effect of continued adverse seasons. Among the Rodents, Mr. Waite reports a species of *Mastacomys*, a Tasmanian genus with previously only a fossil continental representative.

The Birds include the rare *Spathopterus Alexandræ*, which, with the new species, five in number, is beautifully figured. Mr. Keartland's valuable ornithological field notes are a most important feature in this section of the Report.

From the Lizards may be selected two species referable to the genera *Ceramodactylus* and *Ebenavia*—the former previously known only from India and Persia, the latter only from Madagascar. This group seems to furnish the most striking instances of colour-adaptation—if, without any knowledge of the actual surroundings, we may so interpret the unfamiliar and startling brilliance and variety of tint displayed by some of the species figured from Professor Spencer's drawings from nature. Doubtless in this, as in other cases, the narrative portion of the Report will prove to be a source of much interesting information.

From the Mollusca may be singled out a species of *Microphyura*, a genus otherwise known only from New Caledonia; which provides an attractive speculative morsel for Mr. Hedley.

Viewing the results in their relation to geographical distribution some important considerations present themselves. The range of many known species is now for the first time considerably extended. Examples are the Echidna, *Sminthopsis murina* and *S. crassicaudata*, *Antechinomys*, five out of the six frogs, some of the birds and reptiles; among invertebrates the crayfish (*Astacopsis*), the freshwater crab (*Telphusa*), *Apus*, and others of the Entomostraca; and certain molluscs and insects.

Taking the different orders separately, some curious relations manifest themselves. Among the mammals along with characteristic and ubiquitous forms there occur also species found likewise in the inland portions of one or more of each of the mainland colonies. The birds, with the exception of five new species, Mr. North reports to be chiefly species ranging over the southern half of the continent, with a slight preponderance of western forms a slight admixture of north-western species, and an absence of northern species. Among the lizards, together with Eremian and widely dispersed species, there are northern and western forms. Of the frogs, one species is new: the remaining five occur also in the interior of New South Wales or Queensland only one of them (*Hyla rubella*) extending also to West Australia. The land Mollusca, of all the Orders represented, present the largest percentage of endemic forms; their general facies approximating more to that of subtropical West Australia than to any other part of the Continent. From the limited number of genera and their peculiar distribution Prof. Tate regards them as indicating a primitive group whose insularity has long been maintained. The fluviatile Mollusca, however, present species belonging for the most part to Queensland and the Northern Territory.

Considering the fauna of Central Australia as a whole, it will be seen that the regions into which Prof. Tate has proposed to subdivide Australia from botanical considerations are not equally satisfactory from a zoological point of view. Probably no one set of regional subdivisions would entirely suit the views of all specialists.

Another interesting point is strongly brought out. Central Australia furnishes the most striking Australian instance known of the "potency of climate compared with the inefficiency of physical barriers" in regulating geographical distribution. In an interesting address "On the Geographic Distribution of Life in North America," by Dr. Merriam, this author points out that Wallace* greatly underrates the importance of temperature as a factor in determining the distribution of animal life; and he adds:—"It is now pretty generally conceded that temperature and humidity are the chief factors governing the distribution of life, and that temperature is more potent than humidity." Australia is a continental tract, completely isolated, not reaching into very high or very low latitudes, without mountain ranges sufficiently high to reach the snow line, and its shores are washed wholly by tropical or temperate seas. It would seem that Merriam's dictum will not apply to the Eremian Region. In his important Presidential Address at the Sydney Meeting of the Australian Association for the Advancement of Science, Professor Tate said:—"The chief factors influencing the geographic distribution of plants are those of temperature and moisture, because they are indispensable; of the two, so far as Australia is concerned, the latter is by very far the more important." This generalization is now shown to apply equally well to animal life.

Finally, the Report furnishes confirmatory evidence as to the past history of Central Australia, as previously sketched by Prof. Tate and others. The elevated portions of the Larapintine region have continued to be land-surfaces since pre-Cretaceous times. They were insular members of the Archipelago whose shores were washed by the Lower Cretaceous Sea during the period of deposition of the Rolling Downs formation. During the deposition of the Desert Sandstone formation in Upper Cretaceous times they remained to some extent in the condition of islands, but the marine conditions had given place to a lacustrine order of things. With a favourable climate and abundant

* Proc. Biol. Soc. Wash. vii. (1892).

rainfall the partially reclaimed lacustrine area in Pliocene times was gradually opened up to immigration, until the central region must have supported a wonderful fauna including *Diprotodon*, *Nototherium*, large kangaroos, wombats, and crocodiles, &c. Of the remarkable flora which must have coexisted for the support of the gigantic herbivores, we know even less than of the extraordinary fauna. In Post Pliocene times set in the dry period which still continues. Such members of the fauna as could not adapt themselves to the new conditions were driven out.

The Botanical, Geological, and Anthropological Parts of the Report, as well as the Narrative, are still to come. In its complete form therefore this fine work bids fair to be the most comprehensive and complete account of the natural history of any part of Australia ever issued in a self-contained form.

In conclusion it would seem not out of place to tender the hearty congratulations of this Society to Mr. Horn, and to the accomplished naturalists who took part in the expedition, as well as to the various specialists who, in the more prosaic share of working up the material, have still done what they could to crown the work of the expedition with success. The amount of zeal and hard work which Professor Spencer in a three or four-fold capacity has expended on his share of the undertaking is evident enough from a mere inspection of the Report. The style and finish of Mr. Wendel's plates, mostly reproduced from drawings by Professor Spencer, as well as the letter-press, are as much a source of satisfaction as the contemplation of the fact that except in two groups it has not been necessary to go outside the limits of Australia to find specialists able and willing to undertake the necessary systematic work.

On the motion of Mr. R. Etheridge, Junr., seconded by Mr. J. H. Maiden, a very hearty vote of thanks was accorded to the President for his interesting Address.

The Hon. Treasurer read the financial statement of the Society's accounts. The report of the Auditors could not be presented, as one of them was still unavoidably absent from Sydney on official business.